

## Tomato: A Warm Season Soil Conserving Crop



**Rani G. Kumar, Girish K. Panicker\* and Franklin O. Chukwuma**

Tomatoes (*Lycopersicon esculentum*) belong to the *Solanaceae* or nightshade family. This subtropical, tender, fruit/vegetable is a native of Central and South America and journeyed around the world with the Spanish explorers and colonists. Although perennials, tomatoes are generally grown as annuals. It is considered the world's most popular fruit and is the third well-liked vegetable in the United States. Yearly, over eight million tons of tomatoes are produced in the nation.

### **Purposes**

- To conserve soil and water through the use of vegetation
- To maintain and/or to improve soil availability, quality, and soil nutrients
- To suppress weeds, reduce insect pests and diseases, and increase crop yield
- To improve soil tilth, soil organic matter, and soil structure

**Planting:** Tomatoes are warm-season crops that require minimum 6 hours of direct sunlight, every day. Though grown on a wide variety of soils, they prefer loamy soil, a pH between 6 to 7 and temperatures 70 to 80 degrees F day and 60 to 65 F during the night. Positive planting periods are late spring and early summer. Raised beds (around 6 inches high) and drip irrigation ensure optimum yields. To care the plants easily, to produce quality fruits and to avoid diseases, the plants must be supported with stakes, wooden or bamboo poles, strings or a tomato cage. Lately, trench planting method (planting horizontally and bending the stems for a healthy root system and also to uphold the plant above the soil) is quite successful. Plant staked plants 2 feet apart in rows 3 to 4 feet apart, caged plants 30 to 36 inches apart and unstaked tomatoes 3 feet apart in rows 5 feet apart. Tomato flowers are self-pollinating and for faster pollination, the plants should be shaken alertly. Side dressing the first fruits always boosts production. Fruits are ready to harvest (after 55-90 days) when they are firm and evenly colored, at various phases (based on the variety.)

**Soil:** Tomatoes thrive on various mineral soils, but favor well-drained, fertile, deep, slightly acidic, sandy loams. This crop maximizes production in organic rich soil. Incorporating 2/3 inches of organic material compost (grass clippings, leaves, decayed barnyard manures, rotted hay, peat moss, weed teas etc) over the plot or a complete fertilizer, like 10-20-10, 5-20-20, or 8-16-1 and lime into the soil, weeks prior to planting; will retain water infiltration rates and develop soil. Ensure that the fertilizer is low in nitrogen (N), high in phosphorus (P) and moderate/high in potassium (K). Applications of bio-stimulants of seaweed and liquid fish mixture will sustain good organic soil. Being 'heavy feeders', adequate water supply is necessary for Tomatoes during dry periods and fruit growth.

**Mulching** is a beneficial and inexpensive technique practiced in crop production intended to promote and maintain plant health and rapid growth for full season harvest. Mulches are protective layers of organic (compost, leaves, wheat straw, hay, pine needles, grass clippings, bark chips, sawdust etc) or inorganic materials (news papers, stones, brick chips, plastic etc) spread on top of the soil to improve soil structure, conserve water, regulate optimum soil temperature, encourage extensive root growth, provide habitat for earthworms and beneficial soil organisms, reduce erosion, prevent weed growth and fungal disease and minimize fruit contact with soil and rotting. Mulched tomatoes offer highest yields. Mulch should be applied only when the soil temperatures are warm and the tomato plants are well established. Mulching is strongly emphasized for trellised and staked plants to promote water-holding capacity and lessen weed control. Top dressing with fish emulsion and adding extra compost midway through the growing season are recommended for abundant harvest.

**Crop rotation** is a cultural design and an accepted practice in organic farming. In a rotation, botanically unrelated crops are planted in sequence over two or three years. A variety of crops furnish multiple benefits to the maintenance of long and short-term soil fertility and pest management. Rotations reduce erosion, nutrient leaching, pests, insects, and diseases build-up, weather damage and fertilizer/chemical applications and increase soil structural stability, crop water use efficiency, biodiversity, nutrient recycling and production and maximize net profits. Growers use crop rotation as a classic prevention measure and the main non-chemical control in tomato production. Rotating non-solanaceae crops with tomato for three years evidently reduce pests and break disease cycles. Also, planting cucurbitaceous crops or a winter legume cover crop along with tomato is favorable for enriching the soil in nitrogen. Tomato can be preceded by legumes like beans or hairy vetch, green manures, lettuces, spinach or kale. Positive succeeding crops for tomato include cool season cover crops such as cereal rye and hairy vetch, root crops like carrots, radishes or beets and other vegetables like squash, cantaloupe, watermelon, cucumber, okra and herbs.

**Cover crops/Green Manures** are a primary part for the success and longevity of cropping systems. These are annual or perennial herbaceous plants grown mainly between seasons of the cash crop, to cover the croplands, feed and fertilize soils and are tilled down before flowering. Besides, cover crops are used for protecting the soil from erosion, while green manures are grown for adding fertility or organic matter to the soil. Two major cover crops planted together

together for specific reasons are legume and grass varieties. A mixture of these two definitely enhances fertility, soil tilth, biological activity, nutrient conservation, erosion control reserves, biodiversity and the amount of beneficial soil micro organisms, as well as the yield and quality. Leguminous plants “fix” nitrogen and also supply N for the following crop and provide heavy ground cover. Grasses with their deep root systems build soil structure, improve water penetration and control erosion. Moreover, their bio-fumigant/allelopathic effects lessen weeds and insect pressure. Cover crops certainly influence tomato cultivation with nutrient rich soil, weed free medium, healthy plants and quality yield.

**Weed and Pest Control:** In order to maintain a healthy farm, quality produce and bumper harvest, weed and pest control strategies are vital. Integrated pest management techniques are now leading in crop maintenance as well as pest, weed and disease control. A variety of cultural, biological, physical and chemical management tools are operated together for its success. These include botanicals, insecticidal soaps, mineral/biopesticides, chemical sprays, windbreaks, prevention and sanitation practices, good ventilation, optimum temperatures etc.

Cutworms, corn ear worm, armyworm, aphids, European corn borer, thrips, whiteflies, fruit flies, and spider mites cause crop losses. Inter-planting sweet corn as a trap crop destroys tomato fruit worms. Companion plants like dill, basil or borage invite beneficial wasps, whose larvae devour hornworms. Reflective mulches and floating row covers give protection against aphid attacks. Using biological control through ‘farmscaping’ (providing home for favorable insects/organisms: pest predators like ladybird beetles, syrphid flies, lacewings, Trichogramma wasps and birds of prey) is strong in eliminating majority of the pests. Soil solarization, diverse crop rotations, drip irrigation, resistant cultivar planting, compost tea use, combined mixture spraying of Bordeaux or copper spray on new plants and keeping the soil evenly moist will prevent bacterial diseases such as soft rot and leaf rot, early blight and late blight, speck, viruses, anthracnose, spot canker and verticillium wilt. Shun weeds with proper site selection, crop rotation, living mulches, shallow cultivation, regular watering, monitoring, weekly scouting, hand weeding, thorough destruction of post-season vines, etc.

**Disking** is an age-old farming operation used in agriculture for multi-purposes like clearing the farm, breaking up clods and loosening soil, uniform seed bed preparation, root penetration, nutrient and moisture supply and weed management. Timing of disking is important because it affects the vegetative growth and yield, positively or negatively. Disking encourages ridging and surface mulching effect, fast decay of crop residues and limited compaction. Disadvantages of disking include dust, deterioration of soil structure, crop residue and soil loss, labor cost, creation of compaction zones; push up of weed seeds to the surface, etc. Disking wet soils leads to soil compaction, poor root development and minimal yields. At least 3 to 4 weeks prior to the planting of tomato, the site has to be plowed well to promote its penetrating root system.

**Residue Management:** Crop residue management is a required part in scientific conservation planning. Residue cover can protect the soil against raindrop impact, progress soil aggregation and enhance structural attributes, increase infiltration capacity, fix plant nutrients, and restrain weed growth. Decomposition rate of the residue depends on the carbon and nitrogen content, and

the placement of the residue. In the tropics and subtropics, buried residue decomposes faster than the surface residues. Surface residue management is widely used to control erosion, today.

Tomato returns almost 10,500 to 11,500 lbs of fresh residue (1700 to 1850 lbs of dry residue) per acre. This dry residue contains 32.92% carbon and 2.71% nitrogen, and at this rate, this crop returns 560 to 610 lbs of carbon and 45 to 50 lbs of nitrogen per acre. The average residue cover recorded on a heavy soil after the final harvest is 42%. The canopy cover goes up to 50% and 74% after 50 days and 80 days of planting, respectively. It gives the highest leaf area index after 55 days of planting. The maximum root depth and rhizosphere width verified in a heavy soil are 22 inches and 45 inches, respectively. In a trailing system, the maximum canopy width recorded is 25 inches. The utmost canopy width recorded is 26 inches. The highest root/shoot ratio summarized is 0.077 with a stem diameter of 0.9 inches. This crop attains the physiological maturity after 60 days and the senescence starts after 90 days of planting. The average yield recorded in a three-year study on a heavy soil is 37,000 lbs per acre.